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Docket No. BU9-98-225DIV

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REMARKS

An Excess Claim Fee Payment Letter is submitted herewith for three (3) additional total claims:

Claims 8, 15, 23-32, and 34-39 and 41-46 are all the claims presently pending in the application. Claims 8, 15, 23, 27 and 41 have been amended to more particularly define the invention. Claims 43-46 have been added to claim additional features of the claimed invention.

It is noted that the claim amendments are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims or for any statutory requirements of patentability. Further, Applicant specifically states that no amendment to any claim herein should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

Claims 8, 15, 23-25, 27, 29-32, 34-36, 38-39 and 41-42 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zheng, et al. (U.S. Patent No. 5,728,621), in view of Liao (U.S. Patent No. 6,110,795). Claims 26, 28 and 37 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zheng, et al. (U.S. Patent No. 5,728,621), in view of Liao (U.S. Patent No. 6,110,795), and further in view of Kunikiyo (U.S. Patent No. 6,620,703).

These rejections are respectfully traversed in the following discussion.

I. THE CLAIMED INVENTION

The claimed invention (e.g., as recited in claim 1) is directed to a semiconductor substrate having a trench region comprising at least one trench, the trench comprising a single layer of high-density plasma (HDP) oxide having an unpolished upper surface, and a non-trench region having an upper surface which is substantially co-planar with the unpolished upper surface of the single layer of the HDP oxide, the upper surface of the non-trench region including implanted dopants. Importantly, the upper surface of the HDP oxide includes a slightly-etched surface, such that a thickness of the single layer of HDP oxide includes a substantially as-deposited thickness.

Conventional substrates having shallow trench isolation (STI) regions require harsh

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etching or chemical mechanical polishing (CMP) to planarize the surface of the substrate and filler material formed in trenches in the substrate. As a result the surface of the trench fill material includes scratches and chatter marks.

In the claimed substrate, on the other hand, the upper surface of the HDP oxide includes a slightly-etched surface, such that a thickness of the single layer of HDP oxide includes a substantially as-deposited thickness (Application at page 7, line 20-page 8, line 9; Figure 2). By forming the upper surface of the HDP oxide to have a slightly-etched surface, a tight seal can be formed (e.g., around the HDP oxide filler material) during formation of the substrate. This tight seal helps to ensure that the HDP oxide within the trench will not be inadvertently etched when the HDP oxide material outside of the trench (e.g., in a non-trench region) is etched away. This allows the claimed substrate to have a HDP oxide trench fill with a substantially scratch free and substantially uniform upper surface.

II. THE PRIOR ART REFERENCES

A. The Zheng and Liao References

The Examiner alleges that Zheng would have been combined with Liao to form the claimed invention of claims 8, 15, 23-25, 27, 29-32, 34-36, 38-39 and 41-42. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Zheng discloses a method for forming planarized oxide shallow trench isolation. In the Zheng method, a high density plasma (HDP) oxide layer is deposited in the isolation trenches. A layer of spin-on-glass is coated over the HDP oxide layer. The spin-on-glass layer and portions of the HDP oxide layer remaining are polished away so that the substrate is planarized (Zheng at Abstract).

Liao discloses a method of correcting the scratches caused by CMP. In the Liao method, a microscratch formed in an isolation trench caused by chemical mechanical polishing is corrected by forming a sacrificial layer on the damaged trench fill so that the micro-scratch is thus filled with the sacrificial layer. Using a hard mask as an etch stop, the sacrificial layer is

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etched back. Since the etching rate of the sacrificial layer is the same as or lower than the isolation trench material, the formation of the micro-scratch is suppressed during the etching back process (Liao at Abstract).

However, Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, these references are directed to different problems. Specifically, Zheng planarizes a substrate surface by chemical mechanical polishing (CMP), whereas Liao teaches a method of correcting the damage (e.g., microscratches) caused by CMP (Liao at col. 1, lines 13-17). Indeed, Zheng does not even recognize the surface damage (e.g., scratches, chatter marks) caused by CMP and, unlike Liao, does not take any action to correct the damage. Therefore, Liao specifically teaches that the Zheng device is defective. Clearly, these references teach away from each other so that no person of ordinary skill in the art would have considered combining the references.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. Indeed,, the references do not include such a suggestion as alleged by the Examiner. Therefore, Applicant respectfully submits that one of ordinary skill in the art would not have been so motivated to combine the references as alleged by the Examiner. Therefore, the Examiner has failed to make a prima facie case of obviousness.

Moreover, contrary to the Examiner's allegations, neither Zheng nor Liao nor any combination thereof, teaches or suggests *"wherein said upper surface of said HDP oxide comprises a slightly-etched surface, such that a thickness of said single layer of HDP oxide comprises a substantially as-deposited thickness"* as recited, for example, in claims 8, 15 and 23.

As noted above, unlike in conventional substrates, in the claimed substrate, the upper surface of the HDP oxide includes a slightly-etched surface, such that a thickness of the single layer of HDP oxide includes a substantially as-deposited thickness (Application at page 7, line 20-page 8, line 9; Figure 2). By forming the upper surface of the HDP oxide to have a slightly-etched surface, a tight seal can be formed (e.g., around the HDP oxide filler material) during formation of the substrate. This tight seal helps to ensure that the HDP oxide within the trench

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will not be inadvertently etched when the HDP oxide material outside of the trench (e.g., in a non-trench region) is etched away. This allows the claimed substrate to have a HDP oxide trench fill with a substantially scratch free and substantially uniform upper surface.

Clearly, the cited references do not teach or suggest these novel features. Indeed, the Examiner attempts to rely on Figure 10 and col. 3, lines 32-38 to support his argument. However, the Examiner is clearly incorrect.

In fact, Zheng clearly teaches that the oxide areas 18 are etched in order to reduce a step height between active areas 28 and the isolation areas (Zheng at col. 3, lines 35-38). Indeed, this is conceded by the Examiner. Moreover, Zheng goes on to teach that the corners of the oxide 18 are further etched to provide rounded corners.

Applicant respectfully submits that this is completely different than the claimed structure. Indeed, unlike the upper surface 18 in Zheng which is significantly etched in order to reduce the height of the oxide 18 and to shape the oxide 18, the surface of the HDP oxide in the claimed invention is only "slightly-etched". That is, in the claimed invention, the upper surface may be only slightly-etched not to shape or reduce a height of the filler in the trench, but "in order to remove all of that portion of the filler material 50c shown in Figure 1" (Application at page 7, line 21-page 8, line 1). This allows a tight seal to be formed (e.g., around the oxide fill in the trench) which can protect the trench fill (e.g., during a later process).

Moreover, unlike the significant etching in Zheng which is anisotropic, the slightly-etched surface in the claimed invention may be an isotropically-etched (e.g., non-directionally etched) surface (Application at page 8, lines 6-7). This is because, as discussed above, the purpose for the etch in the claimed invention is completely different than that in the Zheng device. Further it is important to note that this significant etching step in Zheng is one problem that the claimed invention is intended to address. That is, such significant etching will likely scratch the surface of the oxide fill, reducing the quality of the fill.

Moreover, Liao clearly does not an HDP oxide in a trench region (e.g., in the trench) having a "slightly-etched surface". Indeed, like Zheng, Liao teaches that an oxide fill is significantly etched during an etch back process (Liao at Abstract; Figure 2E).

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Therefore, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

B. The Kunikiyo Reference

The Examiner alleges that Zheng would have been combined with Laio, and the alleged Zheng/Laio combination would have been further combined with Kunikiyo to form the claimed invention of claims 26, 28 and 37. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Kunikiyo discloses a device having isolation characteristics of an isolation trench which are allegedly enhanced. In the device, elements to be isolated by an isolation trench (STI 2) are formed in active semiconductor regions shown by arrows 30 and 31 on a semiconductor substrate 1. The STI 2 is filled with SiOF (Kunikiyo at Abstract; Figure 1).

However, Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, Zheng and Liao are directed to planarizing isolation regions, whereas Kunikiyo which is intended to improve the isolation characteristics of a isolation trench by using SiOF as a filler material. Clearly, these references are unrelated and no person of ordinary skill in the art would have considered combining the references.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination. Indeed, Applicant respectfully submits that one of ordinary skill in the art would not have been so motivated to combine the references as alleged by the Examiner. Therefore, the Examiner has failed to make a prima facie case of obviousness.

Moreover, contrary to the Examiner's allegations, neither Zheng nor Liao, nor Kunikiyo, nor any combination thereof, teaches or suggests "*wherein said upper surface of said HDP oxide comprises a slightly-etched surface, such that a thickness of said single layer of HDP oxide comprises a substantially as-deposited thickness*" as recited, for example, in claims 8, 15 and 23.

As noted above, unlike in conventional substrates, in the claimed substrate, the upper

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surface of the HDP oxide includes a slightly-etched surface, such that a thickness of the single layer of HDP oxide includes a substantially as-deposited thickness (Application at page 7, line 20-page 8, line 9; Figure 2). By forming the upper surface of the HDP oxide to have a slightly-etched surface, a tight seal can be formed (e.g., around the HDP oxide filler material) during formation of the substrate. This tight seal helps to ensure that the HDP oxide within the trench will not be inadvertently etched when the HDP oxide material outside of the trench (e.g., in a non-trench region) is etched away. This allows the claimed substrate to have a HDP oxide trench fill with a substantially scratch free and substantially uniform upper surface.

Clearly, the cited references do not teach or suggest these novel features. Indeed, Kunikiyo teaches that the SiOF film 40 is "flattened" by CMP (Kunikiyo at Figure 4; col. 11, lines 55-59). That is, nowhere does Kunikiyo teach or suggest an HDP oxide (e.g., in a trench region) having an upper surface which includes a slightly-etched surface, such that a thickness of the single layer of HDP oxide includes a substantially as-deposited thickness. Thus, Kunikiyo clearly does not make up for the deficiencies of the alleged Zheng/Liao combination.

Therefore, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

III. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 8, 15, 23-32, 34-39 and 41-46, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

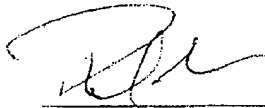
Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

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The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Assignee's Deposit Account No. 09-0456.

Respectfully Submitted,

Date: 8/10/04

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CERTIFICATE OF FACSIMILE TRANSMISSION

I hereby certify that the foregoing Amendment was filed by facsimile with the United States Patent and Trademark Office, Examiner David Blum, Group Art Unit # 2813 at fax number (703) 872-9306 this 10th day of August, 2004.



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